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possibility of getting on the same individual results both with and without the visual component. This is partly met by the experiments on the blind subject, but robs those on the other subjects of some of their directness. The results, however, are in general satisfactory. For details the reader is referred to the original. Volkmann's bilateral effect of practice was not found, possibly because the experiments on this point were not numerous enough and long enough continued. The bilateral effect was strongly marked in the experiments of Dresslar (this JOURNAL VI, pp. 325 ff.). Of incidental observations the following are interesting: the duality of the stimulus in Weber's circle experiments is easier to recognize than the relative direction of the points; the direction is better recognized when a straight edge of length equal to the separation of the points is substituted for them; the blind subject tended to underestimate the breadth of her arm as compared with its length—an effect possibly due to muscular associations.

The third part of the paper is given to a discussion of the psychology of the methods employed, and contains interesting observations on the effect of expectation and of the introduction of blank experiments (*Nullversuche*), i. e., tests whose object is to assure the operator of the state of the subject's attention.

That some such intervention of visual images as the author describes does take place in his own case, is clear to the introspection of the reviewer—certainly in cases where the grade of attention is high. The only wonder is that what seems so obvious and important should have been missed by the many distinguished investigators who have previously worked upon skin sensations. The author refrains from extending her principle of visualization beyond skin sensations, but it doubtless has a much wider scope. In experiments in the Clark laboratory made in the spring of 1895, and upon quite another topic, it incidentally appeared that visualization affected the subject's notion of his posture. The question naturally suggests itself whether there are not other vicarious functionings among the senses, and in general what the mutual relations of the senses are. Indeed, Miss Washburn's suggestion is so wide in possible development as almost to promise a new chapter in experimental psychology.

E. C. S.

Die Umwälzung der Wahrnehmungshypothesen durch die mechanische Methode. Nebst einem Beitrag über die Grenzen der physiologischen Psychologie. Von DR. HERMANN SCHWARZ. Leipzig, 1895, pp. xx-213.

This work consists of three treatises, related to each other only by the fact that they deal with theories of perception. The first—*"Das Problem des unmittelbaren Erkennens"*—traces the development of the general problem of perception from Democritus and Aristotle to Descartes and Hobbes. The second—*"Das Problem der Sinnesqualitäten"*—gives a discussion of the theories of the perception of sensory qualities in Hobbes and Descartes, as compared with the theories of the Greeks and scholastics. The third—*"Ueber die Grenzen der physiologischen Psychologie"*—is a critique of Exner's attempt to explain consciousness on purely physiological grounds. Although not logically connected, the arguments of the first two parts are so similar that we need not give them separate treatment here. Both alike trace the development of perception from the Greeks to Hobbes.

Dr. Schwarz divides epistemological theories into two groups: theories which make all perception perception at a distance (Aristotle), and theories of perception by direct contact (Democritus). The whole tendency of the development of the problem in mediæval and modern philosophy is considered as an attempt to reduce perception at a distance to perception by contact. Much space is given to the attempts of Thomas, Suarez and Biels to get an intermediation between subject and object by means of the hypothetical "species." Stripped of their picturesque, mythical forms of expression, these accounts really mean that the qualities of the external object are in some way transferred to the mind, but that at the same time the object itself is known, and not merely its qualities. With Descartes and Hobbes mythical statement gives place to a mechanical construction. The whole process must be capable of clear statement, in terms of familiar mechanical processes. But the problem still is to obtain some means of intermediation between the object and the mind. And all the theories treated are alike, again, in the fact that they make the intermediaries themselves mere representatives of the external objects: we never know them, but only the objects through them.

The discussion of these theories is very clear, though often clear at the expense of brevity. Some pages are wasted by repetitions, in the second part, of matter already given in the first; but this is accounted for by the fact that the two treatises were written independently. Besides the development of the main argument, many minor problems incidental to the main theses of the various systems are examined with much acuteness, and many grave difficulties in the way of the unity of the several theories satisfactorily removed.

By far the most important of the three articles for the psychologist is the third, the discussion of the limits to the use of physiological processes in explaining psychological phenomena. Dr. Schwarz traces the development of the relation between physiology and psychology through three stages. In the first, the physiologist makes use of psychological elements in drawing his most general distinctions, of animate and inanimate object, and of plant and animal. The physiologist next frees himself from this dependence on psychology, and gives all his explanations in terms of bodily processes, without reference to mental. In the third stage, the present, the psychological is made dependent on the physiological. In this final form, physiological psychology seems to have no need of an introspective foundation. According to Exner, the lower centres determine the activity of the higher, and these in turn condition consciousness. There is no reverse effect, *i. e.*, consciousness has no effect upon the physiological processes. Furthermore, we cannot arrange a causal series of the psychical elements which shall be correlated with the causal series on the physiological side; since the more remote members of the physiological series, the activities of the lower centres, are entirely unconscious. It would appear, then, from Exner's theory, that introspection can give no aid in psychology.

If, however, this explanation is to suffice, it must stand two tests. First, can we readily state the ordinary psychical elements in physiological terms? And, conversely, can we apply the ordinary psychological terms to physiological processes? Exner's explanation, in terms of intensity and localisation of cerebral activity alone, seems to break down in both respects. When reduced to their lowest terms, Exner's sensations are three-dimensional entities; they have intensity, extensity and quality; while his physiological excitations have only two dimensions, intensity and place in the

cortex. This argument becomes still stronger if we add feeling to sensation as a peculiar process. And the difficulties appear yet more clearly when we try to translate our physiological processes into psychological terms. We must assume a conflux of cortical stimuli as the substrate for all complex mental processes. It must be supposed that we have only increase in intensity and extent of stimulation, as we pass from perception to idea and judgment. No sharp line can be drawn between them, in terms of their physiological substrate. No distinction can be made between the nervous excitation at the basis of analysable and unanalysable complexes. Both difficulties seem insoluble from the physiological standpoint.

This criticism would be unanswerable if we interpreted Exner's statements literally. But it is difficult to believe that he intends us to understand that there is no difference in quality (form) of nervous excitation, accompanying difference in the part of the cortex stimulated. If understood literally, Exner seems to have overreached himself in his desire to make his explanations as simple as possible. Moreover, aside from their references to Exner's theory, Dr. Schwarz' objections seem to have overlooked Stumpf's theory of a synergy of cerebral functions, as distinct from local association of functions. Nor would it complicate matters much if we assumed (as we surely have a right to assume) a difference of form, as between nervous excitations, and made this a third physiological attribute. We conclude, therefore, that the criticism of the article is not valid. There are possibilities enough in the variations of neural activity to explain all the facts of consciousness. It is only necessary that we should be willing to sacrifice simplicity to adequacy of explanation.

W. B. PILLSBURY.

Die Physiologie des Geruchs. Von Dr. H. ZWAARDEMAKER, Stabarzt-
Docent in Utrecht. Leipzig, 1895, pp. 324.

A comprehensive work on smell has long been desiderated, and here at last it is with twenty-eight cuts, a good index and register, and 232 titles on the morphology of olfactory organs among vertebrates, and done withal by a student of the subject whose previous brief communications on the subject justified high expectations. Although the author has devoted seven years to research in the field, he publishes reluctantly and upon the exhortation of Dr. Junker, his translator into German, in the hope that students "will devote themselves to this attractive field, which still promises rich harvests of surprising facts and hypotheses of wide bearings." The technique of the author's olfactometry and odorometry is most simple. A larger tube, containing the substance to be smelled, is slid up over a smaller calibrated tube, the end of which curves upward to the nostril, the whole being supported on a frame and worked as a syringe. The apparatus may be double, may work by pressure or by suction, and a branch tube to a Marey drum may be attached to mark time reactions. Each mark on the smaller tube measures one "olfact" of intensity, and in graphic fatigue tables olfacts are conveniently marked off on the ordinate and seconds on the abscissa. The author makes nine classes of purely olfactive odor materials. These he thinks of as located in the olfactory region, so that the energy zones corresponding to the nine classes are marked off by vertical lines, while within each zone is a scale designating the series of an homologous sequence of chemical combinations, these lines being curved to correspond to the curve of an inspiratory current of air. Each of the hypothetical quality